# The Satellite Imagery VIsualization System (SIVIS 1.0) USER'S MANUAL (1.0)

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# 1.0 Introduction

# 1.1 History of SIVIS

The Satellite Imagery VIsualization System, or SIVIS, is a software package specifically designed for providing powerful visualization and analysis of satellite imagery. A suite of analysis tools (which we call gizmos) provides the means to analyze the results from different types of satellite data. The precursor to SIVIS is a software package developed by Todd Berendes of the Institute of Atmospheric Sciences, South Dakota School of Mines and Technology, called the Image VIsualization Classification System, or IVICS. Some references to IVICS may be made throughout the text.

# 1.2 Purposes of SIVIS

The Satellite Imagery Visualization System (SIVIS) is a package specifically designed to allow a user to interact easily with imager data. This package is being developed for use by the NASA Earth Observing System program called the Clouds and the Earth's Radiant Energy System (CERES). One aspect of the CERES effort is to convolve cloud/clear-sky retrievals from high-resolution imager data (VIRS on TRMM; MODIS on EOS-AM and EOS-PM) with lower-resolution broadband radiometric data from CERES. The convolution of imager data with broadband radiometric data serves several purposes, such as to

- improve scene identification within CERES field-of-view,
- provide cloud properties for use in developing new angular distribution models for inversion of broadband radiances to top-ofatmosphere fluxes, and to
- provide clear-sky and cloud-layer properties for subsequent use in calculating surface and atmospheric fluxes.

This package was developed originally to aid in the development of supervised cloud classifiers, including fuzzy logic and neural network schemes. Throughout the past several years, SIVIS has become a great way for a user to work interactively with satellite imagery. Although many new features have been added including those to view output from the CERES Release 2 cloud algorithms, the primary use of SIVIS is for building training sets for supervised cloud classification algorithm development. The development of a robust supervised cloud classification system critically depends on building accurate training sets. Version 1.0 of SIVIS contains many

new features to help select accurate and representative cloud and clear-sky samples, which can be a single pixel or pixel arrays of user-defined dimensions. Recently, a new tool has been added to work interactively with the user to identify and classify pixels for cloud clearing (or cloud masking).

## 1.3 About This Manual

This manual describes the functionality available in version 1.0 of SIVIS. This is the first official release of SIVIS to the research community.

## 1.3.1 Conventions used in this Manual

Conventions used in this manual are as follows:

- ◆ Basic actions of mouse are in **bold italics**
- ◆ Menu names are in "time bold"
- ◆ Keyboard keys are in <**bold italics**>
- ◆ Names of windows are in *italics*
- ◆ △ symbol is used to highlight notes which give users the additional information before moving on.
- ◆ □ symbol is used to highlight hints which give users the information about SIVIS itself and related science background to help you using the tools more efficiently.
- ◆ ≉ symbol is used to highlight shortcuts which save the user time while using SIVIS.

#### 1.3.2 Acronyms used in this Manual

The list of all acronyms used in this manual can be found in Section 5. In addition, a description of AVHRR channels and their differences is also listed in Appendix 5.0.

# 2.0 Getting Started

# 2.1 System Requirements

Before you use SIVIS, make sure your computer meets all the requirements here:

# □ Hint:

You can type the command "hint" on your SGI workstation to get helpful information. ◆ GL graphics library

◆ Main memory size: 32 Mbytes

◆ Graphics board: 24-bit

◆~60 Mb required for SIVIS installation

The SIVIS executable is fairly small, on the order of several Mb. However, there are a number of ancillary data files used in conjunction with the satellite imagery, such as the CIA coastline database (~20m resolution) and the IGBP (International Geosphere Biosphere Programme) surface ecosystem database. The CIA database, by nature of being at a high resolution (about 20 m), increases the SIVIS software size requirements. The CIA database is necessary for viewing high resolution data such as the MODIS Airborne Simulator (MAS) or Landsat. If your computer meets all the requirements above, you can install SIVIS on your computer.

# 2.2 User Interface

Mouse, keyboard, and display windows are used to perform actions and interaction in SIVIS. The mouse is used most of the time to execute actions whereas the keyboard is used to enter text and numbers. Interaction is carried out through display windows.

## 2.2.1 Using Dialog Windows in SIVIS

SIVIS uses a dialogue window to display information before executing an action. There are some items in the window which need to be mentioned:

- ◆ Action buttons: **Accept**, **Ok** and **Ready** buttons save the settings you made and close the window. **Apply** tests the current settings. **Cancel** discards the settings you made, back to the previous status, and close the window. **Reset** allows you to convert the settings to default settings. **Dismiss** and **Close** buttons simply close the window.
- ◆ Light buttons: The function displayed in the light button toggles on or off with the left mouse button.
- ◆ Radio buttons: When activated, other buttons will be released.
- ◆ Input boxes: Allows the user to type a value (text or numerical) into the box.

- ◆ Choice boxes: Although a default option is always provided, pressing and holding down the right mouse button provides a list of choices. An alternative way to move through the list sequentially is to click the left mouse button.
- ◆ Sliders: Allow you to adjust values between fixed bounds by shifting the slider with the mouse using the left button. There are two kinds of sliders: horizontal and vertical.

#### 2.2.2 Mouse controls

A mouse is the most useful tool to choose menu options and pick objects between windows in SIVIS.

There are four basic actions with the mouse buttons:

- ◆ Click A quick press and release of the mouse button.
- ◆ Double Click Single click twice in quick succession.
- ◆ Press Click and hold down the mouse button, then release the mouse button.
- ◆ Drag Press the left mouse button and move the mouse to the desired position before releasing the button.

Basic mouse actions in SIVIS are as follows. Keep in mind that further discussion on where such actions are relevant will be provided as necessary throughout the manual:

- ◆ Choose/Reject main menu option: Move the mouse pointer (▼) to the menu you want to choose. The submenu will appear with a press of the right mouse button. The submenu will disappear when the button is released outside the menu area.
- ◆ Select/Deselect submenu item: Any submenu item may be chosen for execution by first pressing the right mouse button to display the list, moving the pointer to the desired selection, then releasing the button. For the Toolbox and Sample Mode menus only, a small box appears to the left of the selection. The box was included on these two menus to make it easier for the user to see exactly what tools have been chosen. This feature becomes very handy when a number of tools have been opened for an image. Move the mouse pointer (◄) to highlight the item you want to choose. Then click the right mouse button on the check box beside the submenu item. The ✓ sign will appear on the check

box. Clicking the right mouse button again on the checked box will deselect the submenu item. The  $\checkmark$  sign will then disappear.

- $igoplus Press \ action/radio \ button$ : Move mouse pointer ( $\pi$ ) over the button you want to choose, click the left mouse button.
- ♦ *Pick* a choice from a choice box: There are two ways to pick a new choice. One way is by using the left or middle mouse button. Clicking left mouse button on it makes the next choice in the list whereas clicking middle mouse button results the previous choice. Keeping the mouse pressed cycles through the list. The other way is to use the right mouse button. Press the right mouse button on it, the list of choices will appear by then. Hold the mouse down until the choice you want is highlighted, then release the mouse button. The selected choice will show in the box.
- igspace Enter values to input box: Move the mouse pointer ( $\nearrow$ ) into the input box and click the left mouse button within the box. Type in the value you want.
- ◆ Check/uncheck light button: Move the mouse pointer (▼) onto the button you want to choose, and then click the left mouse button. The button will be highlighted with color. To uncheck the button, click the button again. The highlighted color will disappear.
- ◆ *Shift slider*: Move the mouse pointer (**▼**) onto the slider, drag the mouse to move the bar up and down or left and right inside the slider area for adjusting the value, release the mouse until the desired value reaches.
- ◆ Locate sampling area: Move the mouse pointer (▼) to the location of the area you are interested in, and click the left mouse button. If using single or multi-sample mode, a box (the size of which can be specified uner "Preferences") will appear. For "drag box" mode, drag the mouse to draw a rubber-band box of desired size. Clicking the middle mouse button will select the subsamples when you use multi-sampling mode.

#### 2.2.3 Keyboard Shortcuts

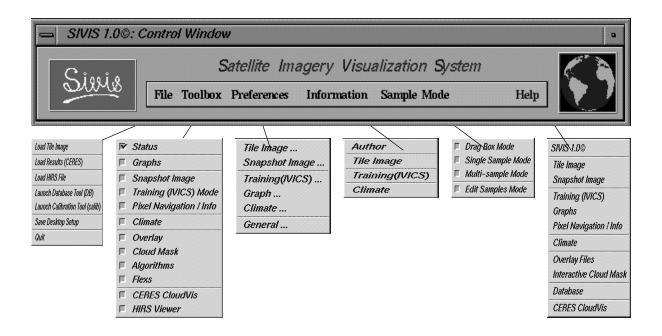
You can also choose menu options by using keyboard shortcuts. There will be several windows opened at the same time in a limited window size while using SIVIS. SIVIS provides a quick way to close the unwanted window by *pressing* <*Ctrl\_q*>. If you are a good typist, it is even faster to use the keyboard than the mouse. SIVIS provides keyboard shortcuts for each menu selection. They show on the right side of the menu options. This feature is under development.

# 3.0 SIVIS BASICS

#### 3.1 Overview

As stated in the introduction, the strength of SIVIS lies in its ability to transform very large native-format imager data files into "view"-able images. This section explains the physical process of converting data files into SIVIS format while explaining what algorithms are being performed on the data to make the files "view"-able. Loading and viewing files in SIVIS are then explained.

The first logical step in becoming a SIVIS expert begins with typing the word *sivis* on the command line of your computer. This will initiate a SIVIS session bringing up the SIVIS *Control*, *Tile Image* and *Status Toolbox* windows. The *Tile Image* and *Status Toolbox* windows are initiated once a file is loaded, and will be explained in the following sections. There are six main menus located in the *Control* Window: "File", "Toolbox", "Preferences", "Information", "Sample Mode", and "Help". Figure 1 shows the main menus and their submenus. As previously mentioned, all data files (MODIS, AVHRR, LANDSAT, etc.) must be calibrated before being ingested into SIVIS. The next section explains the calibration process for AVHRR data files. After data files are calibrated, they can then be loaded and viewed. Section 3.3 explains how to load an image, and section 3.4 explains the process of how the data files are transferred from numeric files to "view"-able images.



#### Main Menus and their Submenus

#### FIGURE 1.

# 3.2 Converting a data file into SIVIS Format

All data files must first be calibrated and converted to a tile format before they may be used in SIVIS. The purposes of calibration and conversion are threefold. First, calibration assures that data files are correctly amended for corrections due to satellite sensor degradation and other calibration problems. Second, conversion of the physical quantities (brightness temperatures and reflectivities) to character data in a "tile" format allows SIVIS to efficiently manipulate and display the data. Third, overlay files are created for coastlines, islands, rivers, etc. for each scene during the calibration process. This greatly speeds up the SIVIS software once an image is loaded for analysis.

Converting a raw file into SIVIS format actually creates a new file with the same name as the original file but adds a ".til" extension. The new ".til" file size is approximately 20% larger than the original file. Keep this in mind when working with limited disk space. File conversion (and calibration) can be done from within or from outside the SIVIS environment.

#### ☐ Hint:

Calibration creates a new file that is slightly larger than the original data file. Keep this in mind when working with limited disk space.

# △ Note:

ALL data files MUST be calibrated before loading.

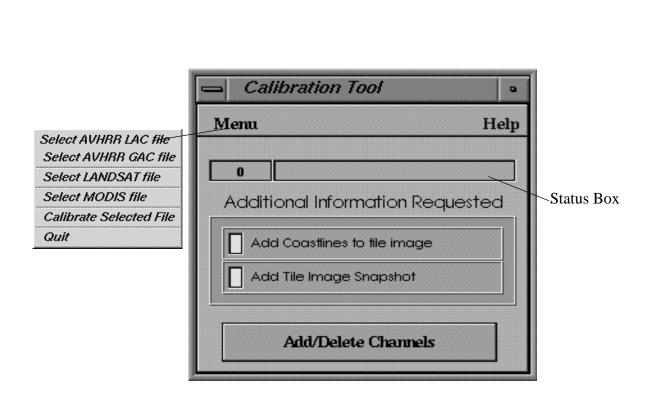
### ☐ Hint:

Calibration can also be done by typing "calib" on the command line. The calibration tool window will show up. There are several steps in the conversion process:

- ➡ ① Calibration can be done from within the **SIVIS** environment by dragging down the "**File**" menu to "**Launch Calibration Tool (calib)**". The calibration tool may also be initiated from outside the SIVIS environment by typing "calib" on a command line in a unix window. Either way, once the tool executable is launched, the *Calibration Tool* window will show up (Figure 2).
- ⇔ ② *Select* the image you want to calibrate. There are four choices in the Menu: Select AVHRR LAC file, Select AVHRR GAC file, Select LANDSAT file, and Select MODIS file. Calibration for LANDSAT data is not available in this version (SIVIS 1.0) but will be soon. After you select one of the available choices, the *File Selector* window will show up (see Figure 3). Procedures for choosing an image file are the same as in steps ③ and ④ for "Loading An Image" in Chapter 3.3.
- □ ③ Press "Add/Delete Channels". The Channel Selection *Tool* window will appear (See Figure 4). There are lists of currently selected channels and available channel choices in this window. To delete a choice from the list, **Double click** a choice in currently selected channels. To add a choice to the list of currently selected channels, Double click a choice in available channel choices. There is a box on the right top side of the window named **Bytes** per Pixel. This option has implications when performing any numeric analysis. Calibrating a file with the one byte option converts all real numbers to have values between 1 and 256. For example, if the brightness temperature of an IR channel has limits of 200 to 327.5 K, each gray scale count will correspond to 0.5K. With the two-byte option, the brightness temperature will have full precision. Hence, the two-byte option is preferred when the desired precision is greater than 0.5 degree. The trade-off is that the two-byte option will result in a ".til" file that is twice the size of a file calibrated using the 1-byte option. The usual way images are calibrated is to choose a single byte option. The other two boxes below the **Bytes per Pixel** box give also you the ability to set a range of values for the physical unit to grey scale conversion process: the maximum and minimum value of the selected channel choice. Once modifications have been completed for the channel list, press the **Done Selection** button to close the *Channel Selection Tool* window. If user wants to save the selection, simply press the

**save selection to defaults** button before closing this window.

- □ ⊕ Checking/Unchecking the Add Coastlines to tile image and Add Tile Image Snapshot buttons will activate/ deactivate the coastlines on image and the snapshot image.
- ⇔ Select Calibrate Selected File from Menu to initiate the calibration process. The status box in the calibration tool window will show you the progress of the calibration. If the calibration step is successful, a new file will be formed with the same name as the raw file but with an additional ".til" extension. The *message* window will show on the window. *Click* ok on the *message* window to close it.
- ➡ ⑤ *Select* **Quit** from **Menu.** It will close this window and exit the Calibration tool.



☐ Hint:

Depending on the

file, creation of the SIVIS input file may

take quite a while.

size of the input data

FIGURE 2.

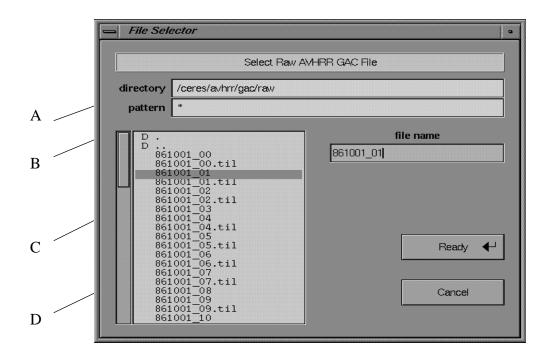


FIGURE 3.

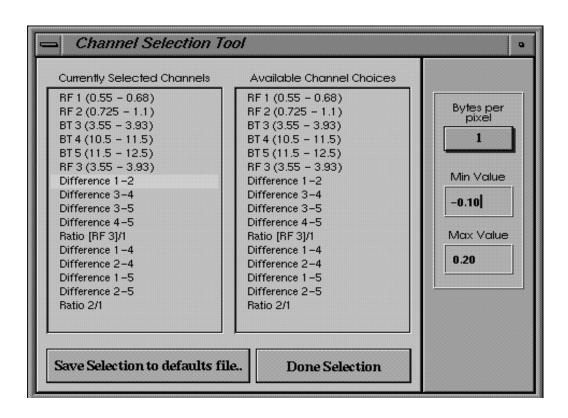


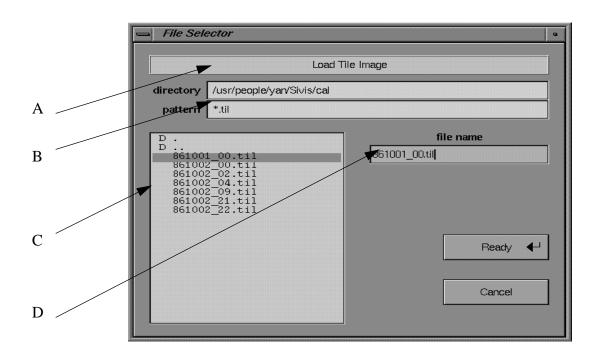
FIGURE 4.

# 3.3 Loading An Image

Once a ".til" file is created, it can then be loaded into SIVIS. SIVIS allows the analyst the ability to view high-resolution satellite images. The main SIVIS *Tile Image* window will show only a small portion of the image, but a reduced resolution version of the whole image is also displayed in the *Snapshot* window (available from a pull-down menu available in the **Toolbox**).

There are several steps for loading an image:

- ☐ Choose menu option "File" using the right mouse button. A list of options should appear at this point (Figure 1).
- ➡ ② *Select* submenu option "**Load Tile Image**" using the right mouse button. The file dialogue window should appear (Figure 5).



#### **Shortcut:**

A quick way to load an image file is to double click the selected image name located in the file list box (Figure 5, letter C).

#### FIGURE 5.

➡ ③ If the directory shown in the directory box is not correct, move the mouse pointer (**π**) inside the directory box (Figure 5, letter A) and click the left mouse button. The form shown in Figure 6 should appear. *Enter* the new directory in this box and *Press* "OK". The same procedure should be followed if you want to change the pattern of

image files in the pattern box (Figure 5, letter B). The form shown in Figure 7 should appear. *Enter* the new pattern in this box and *Press* "OK". The image names which are located in this directory and which follow the form of the pattern should appear in the file list box (Figure 5, letter C).



FIGURE 6.



FIGURE 7.

♣ Select the image name in the file list box. The chosen image name should also appear in the file name box (Figure 5, letter D). Press "Ready", or hit <Enter> on the keyboard to accept the selection. The dialogue window disappears and the image will show on Tile Image window. Pressing on "Cancel" in the dialogue window will reject the selection you just made in the dialogue window and also close the dialogue window.

There is another way to define your working directories where the image, results and overlay files are by *selecting* "General..." from the main menu "Preferences" in the *Control* window. The *General Preferences* window will show up (Figure 8):

**◆***Enter* the directories you are working on to the area in this window (Figure 8, letter C), *Select* "Save Setting to **Defaults**" from "Menu", which is located in ~HOME/. sivis\_default directory. SIVIS will go to the directory auto-

matically while loading it next time. Pressing the "**Dismiss**" button will close *General Preferences* window.

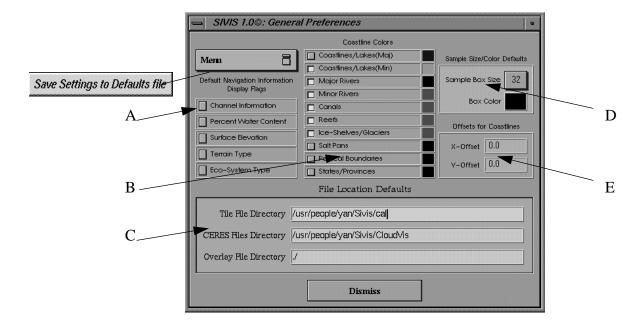


FIGURE 8.

# 3.4 Tile image

Visualization in SIVIS works on the basic principle of converting radiometric data into an appropriate range of "grey" tones for display. These tones can also be displayed within the Red/Green/Blue color framework which allows any 3 channels to be overlayed to create "full-color" images. The user has the choice of determining which channels to display and what colors to map the data into, creating "false-color" imagery. In addition, there are a suite of tools to allow the analyst to "tune" the image by changing the contrast. Examples of these tools are explained in section 3.4.1.

By default, AVHRR channel 4 is mapped into both the red and green bins, and channel 1 is mapped into the blue bins. Of course, this default may be changed. The channel settings of the displayed image are depicted in the upper right-hand corner of the main SIVIS screen. In addition, brief information about the image is provided including the file name, time (GMT); and Julian day. If you want more detailed information about the image you have selected for visualization/analysis, *select* "Tile Image" from "Information".

The user has the ability to change any of the default settings in the false color image; this utility is discussed in more detail in the next section.

The image in the *Tile Image* window is only part of the entire data file. It currently contains an array with dimensions of 512 by 512. The resolution of the image shown on this window is a function of the instrument type. Currently, AVHRR LAC (local area coverage, 1.1-km resolution at nadir) and GAC (global area coverage, 4-km resolution at nadir) Level 1-B (NOAA format) data sets may be calibrated and implemented into SIVIS. SIVIS can also support input of MODIS data.

Once the image has been loaded, you can *navigate* east, west, north, or south by single clicking the arrows located on the side walls of the *Tile Image* window (See Plate 1 in the end of the manual). If the location you desire is located at the far end of the image, use the slide bars. The bar are implemented by moving the mouse pointer  $(\pi)$  over the selected bar. Press and drag the bar using the left mouse button to the desired location.

A second method to navigate the full image is to move the mouse into the image *Snapshot* window, and click down on the left mouse button. This will initiate a "pulsating" red box that represents the area covered in the *Tile Image* window. *Keep the button depressed*, and move the box to the desired location; then release the mouse button, and the newly selected region will appear in the *Tile Image* window. The image *Snapshot* is discussed in section 3.6.

Also, by default, a series of map overlays are placed on the image (both the *Tile Image* and *Snapshot*) to aid in image navigation. You also can modify the color settings of the these overlays (e.g. coastlines) by *selecting* "General..." from main menu "Preferences" in the *Control* window. The *General Preferences* window will show up (See Figure 8). There is an area (Figure 8, letter D) for Coastline Color defaults in this window. *Check/Uncheck* the display buttons in the left side of each category will activate/deactivate the colors shown on the image. You also can change the color by pressing each colored button. The color map will show up (See Plate 2 in the end of the manual). You can scroll through the color map to see more entries. *Clicking* on the desired entry will select the color you want. You also can decide not to change this color by *Pressing* "Cancel" button. *Pressing* "Dismiss" button will close *General References* window.

# 3.4.1 Image Object Settings

The Image Object Settings window provides a mechanism to view and alter the *Tile Image* and *Snapshot Image* color settings. Accessing this gizmo is explained as follows:

There are two ways of pulling up the *Image Object Setting* window. The easiest method is to move the mouse into the *Tile Image* or *Snapshot Image* windows. Then click the right mouse button. The other method is to *Select* "Tile Image" from "Preferences" on the SIVIS Control Window. In either case, the *Image Object Settings* window will pop up somewhere on the screen.(See Plate 3 in the end of the manual).

The user has many options within the *Image Object Settings*. Each requires a brief explanation. The default channel/color combinations are depicted in the shadowed boxes below the color titles. The **channel/color combinations are altered** by clicking the right mouse button from within the shadowed box in which you want to change. For example, to achieve a true grey scale image of any single channel, change all three boxes to the same channel. Notice that there are many more choices for visualization than just the single channels for the instrument in use. For AVHRR, there are 16 choices. These are determined during the SIVIS calibrated/conversion stage.

The radio buttons at the bottom of each color menu give the user several choices to enhance the SIVIS screen. **Grey scale flip** simply takes the grey scale value for each pixel, and subtracts it from 256. The effect of this operations makes "white" pixels "black", and vice versa. The most popular use of this feature is to flip IR values such that cold clouds appear white and warm surfaces appear black.

The **contrast stretch** technique searches the ENTIRE data file for the maximum and minimum grey values for the channel selected, and then refits the "reduced" max/min range into 256 grey levels. For large data files, this technique will have a minimal effect since the range of grey values is very close to the initial 1 to 256 range. On smaller data files with a shorter range, this technique can have a pronounced effect.

The **histogram equalize** technique is somewhat similar to the contrast stretch in that it seeks to "spread out" data files that have a large concentration of pixels within a small range of the grey scale. The difference lies in the method used to "spread-out" the distribution of points.

# **Shortcut:**

Pressing the right mouse button on any image window will invoke the Image Object Settings The **histogram equalize** technique performs a non-linear fit to the histograms of points with the desired effect to place equal number of points into each grey scale bin. This technique will have a more pronounced effect on larger data files than the **contrast stretch** does.

The **Bright and Contrast slider bars** give the analyst the opportunity to perform manual contrast stretches. The difference between these tools and the contrast stretch radio button is that the slider bars allows the user to set the minimum and maximum values to use in the "refitted" 1 to 256 grey scale, whereas the contrast stretch technique automatically sets the range by scanning the whole file for the maximum and minimum values.

The previously described techniques are applied to one color at a time allowing for a great degree of customizing. Although, if the user desires to apply the same technique to all three colors, he or she may activate the **master mode** radio buttons in the top right-hand corner of the window. The selection radio button activates the channel selection, **Grey Flip**, **Contrast Stretch**, and **Histogram Equalize** buttons/selectors. The slider button activates the **Bright** and **Contrast** slider bars. Once either of these two buttons is activated, any change made to one of the aforementioned buttons will make the change for ALL three colors.

The **Preferences** menu allows you to choose a settings from an existing file or save the settings to a file. Default settings (each user may have several preferred combinations depending on the applications) are saved in files with a ".def" extension. There are three options under the Preferences menu:

- ◆ Load User Defined Settings Allows you to choose the settings from a file (See Figure 9). The procedures for loading the file are the same as steps ③ and J@for Loading An Image in chapter 3.3.
- ◆ Save Current Settings Allows you to save the current settings to a file (".def" extension used by default, see Figure 10). The procedures for saving the file are the same as steps ③ and )④ for Loading An Image in chapter 3.3.
- ◆ Save Current Settings to Defaults file Allows you to save the current settings to a default file which is located in the user's ~HOME/.sivis\_default directory.

Once the user has saved his/her settings to a file, *Pressing the* "**Reset**" button located on the left bottom of the window will ini-

## ☐ Hint:

There are two Master Modes buttons which are located on the right top of the window: Selection and Slider. Check these buttons when you want to make the same change to the settings of all three colors. Unchecking them allows you to modify the settings for the three colors

# ☐ <u>Hint:</u>

Save settings during SIVIS sessions. Then retrieving settings can then be done by clicking the right mouse button to bring Image Object Settings window up and press reset button in this window to reflect the new default settings on your image.

tiate the default settings. *Pressing the* "Dismiss" button will kill the *Image Object Settings* screen.

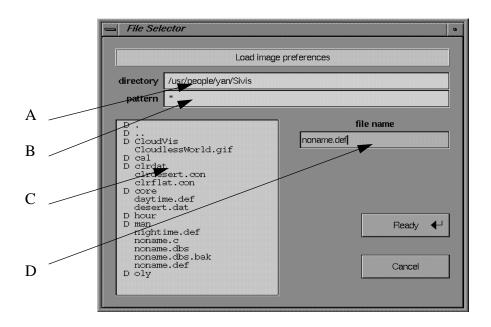


FIGURE 9.

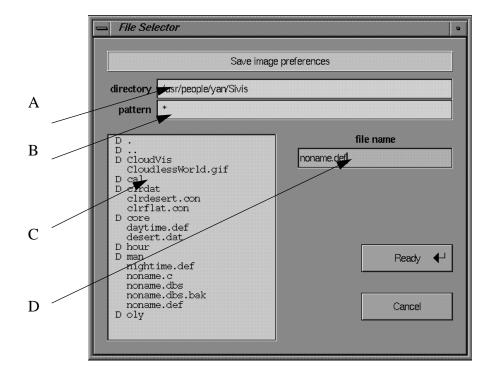


FIGURE 10.

# 3.5 Status Toolbox

The *Status Toolbox* (Figure 11) provides the user with pertinent information during the execution of SIVIS. Examples of this would include actions you requested and error messages. For example, the status window provides clues to the user if an option is used incorrectly. Since the toolbox provides an excellent log of operations performed during a SIVIS session, it is initiated at start-up, and should be kept in the background. There is a scroll bar on the left side of the window in case you need to view previous messages.

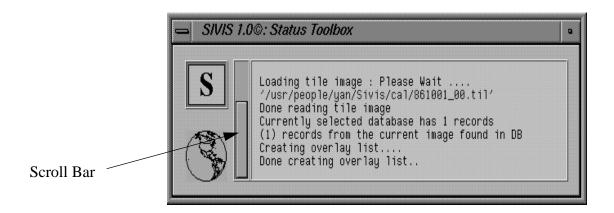


FIGURE 11.

# 3.6 Snapshot Image

#### **Shortcut:**

The user may define the Image Object Settings on the Tile Image window before loading Snapshot. The Snapshot window will automatically follow the Tile Image Settings. The *snapshot* window can be initiated by *selecting Snapshot Image* from the "**Toolbox**". The **Image Object Settings** for the *Snapshot Image* will be the same as for the *Tile Image*. The view shown on this window is the entire image unless the file is larger than 50 megabytes. For files larger than 50 megabytes, a scroll bar will be initiated on the right side of the window. The scroll bar provides a mechanism to allow the user to view the whole image by moving the bar up and down. The subsampling factors for both the x and y axes used to display the *Snapshot Image* appear on the top of this window. The following table lists the scaling factor, memory requirements and the appearance of the images for different data sets with respect to the number of scanlines:

TABLE 1.

	AVHRR_GAC		AVHRR_LAC		MODIS	
Number of Scanlines	Sample	Appearance	Sample	Appearance	Sample	Appearance
<=1024	2	Very Good	8	Very Good	4	Very Good
1025 - 4096	4	Good	8	Very Good	8	Very Good
4097 - 8192	4	Good	16	Good	16	Good
8193 - 16384	4	Good	16	Good		
16385 - 33000	8	Decent	16	Good		
	16	Blocky				

#### 

You can't deactivate coastlines on the snapshot window, but you can do it on the Tile Image window.

#### $\square$ Hint:

The colored box on the snapshot window always indicates the area shown within the Tile Image window. From the table above, you can see that the bigger the image file is, the less resolution the *Snapshot* window shows. You will see some resolution loss (the image will appear blocky) on the *snapshot* window if the file is more than 100 megabytes. Some images may have dramatic color changes on both sides of a curved line which demarcates day from night. "Night" is initiated once the solar zenith angle exceeds 85°. If only infrared channels are used for deriving the false color imagery (done during calibrate image step), there will be no color demarcation along the 85 degree solar zenith isoline. This toolbox gives you a quick snapshot of the whole image and helps you to navigate within the image.

When the data file is successfully loaded into SIVIS, the region covered in the *Tile Image* main window will be represented by the area within the "red rectangle" overlay placed in the upper left-hand corner of the *Snapshot window*. You can *move* the box anywhere you are interested in the *Snapshot* window by clicking the left mouse button from within the *Snapshot* area, and holding it down until you have placed the box over the area of interest. The image on the *Tile Image* window will change accordingly (See Plate 1 in the end of the manual.

# 3.7 Save Desktop Setup

It is common to have several SIVIS windows open at the same time. It is a good habit to save the desktop you are working on so you will get the same settings next time SIVIS is run. To do this, launch **Save Desktop Setup** from **File**. Currently, only one group of settings can be saved, and the new settings will replace the old ones.

# 3.8 Quitting SIVIS

To quit SIVIS:

## **Shortcut:**

You can achieve the same result by moving the mouse pointer (▼) over "File", holding the right mouse button and dragging the mouse pointer (▼) down to the menu until "Quit" is highlighted; then release the mouse button.

- ⇔ ① On the Control Window, *Choose* the main menu option "**File**". A list of options should appear at this point (See Figure 1).
- ⇔ ② Select the option "Quit"; The form shown in Figure 12 should appear.
- □ ③ *Press* "Yes" to confirm it; otherwise, *Press* "No".



FIGURE 12.

# 4.0 Advanced Concepts

## 4.1 Overview

To activate any of the toolboxes, simply *select* the submenus under "**Toolbox**". Not all the tools in the box are activated in this version of SIVIS. Those that are not in bold type cannot be accessed. Basic functionality of the "highlighted" tools are as follows:

◆ **Graphs** - Displays various distributions of data within user-selected regions. The user may choose up to four graphs concurrently that display, for any chosen data sample, any combination of data from any channels. This tool is discussed further in section 4.2.

- ◆ Training(IVICS) Mode Allows you to gather samples from the image and save to database for cloud classification.
- ♦ Pixel/Navigation Info Provides information for any pixel in the *Tile Image* window, such as individual channel reflectances or brightness temperatures, latitude, longitude, solar zenith and satellite viewing angles, surface ecosystem type, surface elevation, and the exact time the satellite measurement was made.
- ◆ Overlay allows user to display additional information overlaid on top of the image.
- ◆ Cloud Mask Allows users to test different algorithms by setting different thresholds and colors.
- ♦ CERES CloudVis This option is designed specifically for members of the CERES cloud retrieval working group. As part of the global cloud retrieval effort, this option allows the user to view results from any algorithm currently implemented in the CERES cloud code. Data files are provided upon request to the CERES team.
- ♦ HIRS Viewer is designed to let the user view cloud retrieval results from HIRS data analysis. Mainly, this is of value to those who want to overlay HIRS retrieved cloud results with AVHRR imagery. There is a specific data structure required for the HIRS results, and this information is available upon request.

# 4.2 Graphs Toolbox

The *Graphs* tool in SIVIS provides a mechanism to display various distributions of data within user-selected regions. The primary visualization graph type is the XY plot, which allows the user to see a variety of scatter plots of the raw data within a chosen data sample. A second plot type is based on the spatial coherence method. Basic XY plots allow the user to view scatter plots from reflectance-brightness temperature data within an array, or scatter plots of brightness temperature differences (BTD), or any other combination of channel pairs.

This tool is used in conjunction with the *Sample Mode* text icon in the main SIVIS *Control Window*. All plots generated using the *Graphs* tool are constructed with data gathered from one of three

# △ Note:

The Sample Mode MUST be chosen from the main Control Window before running the Graphs tool. *Sample Modes*. The first three choices in the *Sample Mode* menu are explained below.

The procedure for using the *Graphs* toolbox is as follows:

- ◆ **Drag Box Mode** Allows the user to draw a sample box whose size is determined by pressing the left mouse button at the top left corner of the box and dragging down and across until the box is the desired size, then releasing the mouse button. The maximum size of this box is 256x256 pixels.
- ◆ Single Sample Mode Fixed sample size for sampling. The default sampling mode is set for a 32x32 pixel array. You can change the size of the sample and the color of the box outlining the sample by *selecting* "General..." from "Preferences" (Figure 8, letter A).
- ◆ Multi-Sample Mode Allows the user to form an array of individual samples of a predetermined size.
- ◆ Edit Samples Mode Allows the user to edit the database saved previously by *double clicking* on the samples within the *Tile Image*. It will bring you the DB Edit windows (See figure 23).

Default settings for the Sample Mode may be altered by entering the *Preferences* drag-down menu, and scrolling down to the **General...** text icon. There are two items in the letter A area on this window: **Sample Size** and **Box Color.** *Press* "Apply" button to accept the modifications or "Cancel" button if you change your mind. *Pressing* "Cancel" button also closes this window. As with all preferences, the user can save any set of preferences so that they become the default choices when using SIVIS next time. After you *select* one of the three choices, the ✓ sign will appear on the left side of the submenu.

➡ ② *Select* "Graphs" from the "Toolbox" menu (Figure 13). The *Graph* window appears with default settings of two graphs set to Spatial Coherence and channel 3-4 versus channel 4 Brightness Temperature Differences. For AVHRR, this corresponds to the 3.7-11 micron brightness temperature difference versus 11 micron brightness temperatures.

# △ Note:

Image must be loaded before **choosing** "Sample Modes".

#### ☐ Hint:

You can do the graph setting first before loading graph toolbox by Selecting submenu "Graph Preferences" from "Preferences". The *graphs* tool is quite powerful, and contains many options ranging from the number of graphs shown to the types of variables displayed. To explore these options, *click* on the "**Graph Preferences**" button located on the top left of the window. The *Graph Preferences* window will appear (Figure 14).

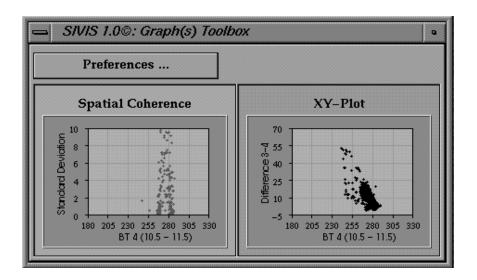


FIGURE 13.

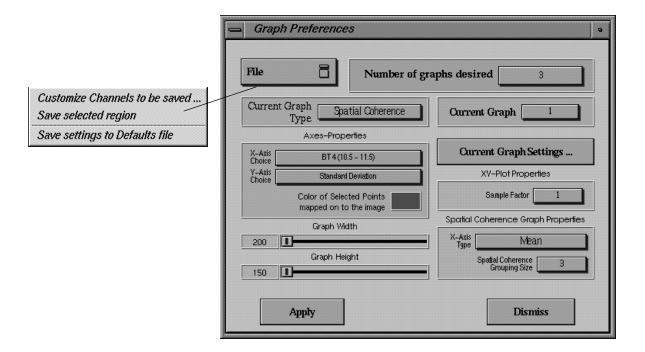


FIGURE 14.

There are several options on this window that the user can use to modify the settings of graphs:

- ◆ Number of graphs desired By *pressing* the right mouse button, the user can select the number of graphs desired (from 1 to 4). If the left mouse button is used instead of the right mouse button, the number of graphs will increment successively from 1 to 4. Once the number of graphs has been chosen, *clicking* on the Apply button in the bottom left corner will show the graphs on the screen. For up to four graphs, the graphs appear in a row and are numbered from left to right.
- ◆ Current Graph Allows the user to set up each of the graphs individually. This menu choice **should be selected first** when setting up single graph attributes. Once the user has set the current graph, the graph type may be selected.
- ◆ Current Graph Type Allows the user to set the type for current graph. Current choices are Spatial Coherence or XY-Plot. Once the type is set, the following three sets of graph properties may be set.

- ◆ Axes-Properties For XY Plot *Current Graph Types*, *Clicking* right mouse button allows the user to set the desired value for the abscissa and ordinate for the X-Y plot. The *Color of Selected Points mapped on the image* is **NOT** activated in this version of SIVIS.
- ◆ XY-Plot Properties For XY Plot *Current Graph Types*, the Sample factor can be set to reduce the number of points plotted from a selected region. Subsampling ranges from the default of 1 (all points plotted), to 5 (every 5th plot plotted).
- ◆ Spatial Coherence Graph Properties For Spatial Coherence *Current Graph Types*, the X-Axis Type icon allows the user to choose either Mean or Median for the absicca, and Grouping Size for such calculations. Choices range from the default of 2 to 7.
- ◆ Graph Width and Height To adjust the width and height of ALL plots, a pair of slider bars is provided that allow the user to adjust the width and height of the graphs. Use the left mouse button to alter the slider bar settings.
- ◆ File An option is provided to save the data within a selected region into a named file. Customize Channels to be saved Allows the user to select the channels (or channel combinations) to save within a region. Simply *click* on the channels desired (figure 15). For AVHRR if the user does not manually choose the desired combinations, the default settings include reflectivity of Channel 1, 2, and 3, plus the brightness temperature of 3, 4, and 5. Save Selected region Allows the user to save the data from a selected region (figure 16). The user must enter a file name, or the default name of noname.dat will be used. The data which will be saved are described above. Save settings to Defaults file Allows the user to save the setting for all Graph attributes to a defaults file which is located in the user's home directory called ".sivis default".

# ☐ Hint:

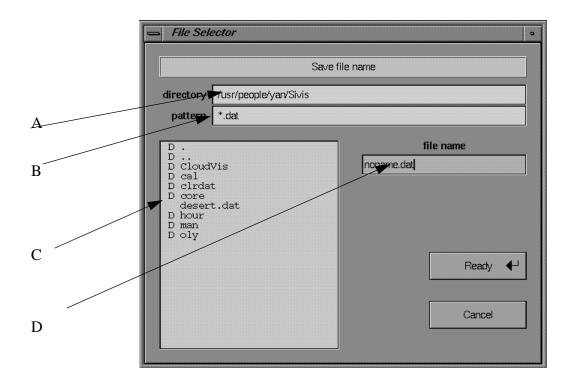
If you want fine control of the value on the sliders, hold down the left or right <**shift**> key while moving them.

## $\square$ Hint:

If you like to use your own settings most of the time, it is recommended that you save them to a defaults file. The default file resides in your home directory.

Output Selection	۰
Latitude	1
Longitude	l I
Image X-Coordinate	
Image V-Coordinate	İ
Time	Ī
☐ Viewing Zenith Angle	İ
Solar Zenith Angle	İ
Azimuthal Angle	İ
Eco-System	İ
Terrain Type	ĺ
RF1 (0.55 - 0.68)	ĺ
RF 2 (0.725 - 1.1)	
BT 3 (3.55 - 3.93)	
BT 4 (10.5 - 11.5)	
BT5 (11.5 - 12.5)	
☐ RF3 (3.55 - 3.93)	
☐ Difference 1 –2	
Difference 3-4	
Difference 3-5	
Difference 4-5	
Ratio [RF 3]/1	
☐ Difference 1 –4	
Difference 2-4	
Difference 1-5	
Difference 2-5	
Ratio 2/1	
Accept Cancel	

FIGURE 15.



#### FIGURE 16.

◆ Current Graph Settings - a gizmo provided to assist the user in analyzing the graph, or graphs, more efficiently. The user may change many of the graph attributes including max/min axis coordinates, text size, and graph colors. See Chapter 4.2.1 for further explanation.

#### 4.2.1 Graph Settings

The *graph settings* tool (See Figure 17) may be accessed by two methods. The first is the button in the *Graph Preferences* window. The second method involves *clicking* the right mouse button on a graph the user wishes to alter. Once any changes are made, the user accepts the changes by *pressing* the **Apply** button at the bottom left corner of the window. Otherwise, *pressing* the **Dismiss** button will close the window. The following list explains the available options:

- ◆ **Display Type** Default and only current choice is scatter plot
- ◆ **Selection Type** There are manual and auto selections to adjust the graphs.
- ◆ **Graph Type** Currently only lin-lin option available.

## **Shortcut:**

Pressing the right mouse button on any graph will invoke **Graph Settings** Gizmo.

- ◆ Flip Axes- Allows the user to invert the data range of each axis.
- ◆ Title and Label Font, Title and Label Font Size, and X and Y axis Label Format Allows the user to change the NUMERIC x and y axis font, size and format. *Pressing* the right mouse button allows the user to set up the font and size for the graph. If the user *clicks* the left mouse button, the selection will sequentially toggle through the possible choices.
- ◆ Current Graph Current SIVIS only has one choice: set 0 which comes from the current samples user selects. User can load their theoretical graph files which will become set 1, set 2, and so forth. These sets will overlay on set 0 to help user analyze the data. This feature is under development now.
- ◆ ALL Color selections *Clicking* the middle mouse button will spawn a palette of graph colors. *Clicking* the left mouse button on a color will reset the graph color.
- ◆ Point thickness Changes the size of the data points in the scatter plots.
- ◆ **Show Grid** Shows a grid superimposed on the graph.
- ◆ # Points Outside the Graph Gives the user the number of points which are not shown in Graph based on current settings. Iteratively increasing the max and min values of the x and y coordinates should bring this value to zero.
- ◆ Tick Length Length of the tick on each graph.
- ◆ # X and Y Ticks Sets the number of tick marks on the axes.
- ◆ X- and Y- Axis Limits Sets min/max values for axes.
- ◆ X- and Y- Axis Title Allows the user to type in the title for each axis.

Graph Settings	-
Display Type  Scatter Plot Line Plot Symbol Plot	Title Font Avant Garde - Book Title Font Size 8  Label Font Size 8  Label Font Size 8
Selection Type  Manual Selection  Auto Selection	X-Axis Label Format 4.0  Y-Axis Label Format 3.0  Show Labels  X-Axis  Y-Axis  Y-Axis
Graph Type Lin-Lin	Current Set 0  Graph  Color Back Gnd.  Show Grid
Flip Axes  X-Axis Y-Axis	Axes Color Back Gnd. Grid Size  Text Color Color 30
Tick Length 2 # X Ticks 5 # Y Ticks 5 X-Axis Title BT 4 (10	#Points Outside the Graph
Apply	Dismiss

FIGURE 17.

# 4.3 Training (IVICS) Mode

This toolbox allows you to gather different samples from the image and save them to a database file. The selected samples should have representative characteristics to be used in supervised cloud classificaton. To begin training, Select "Training (IVICS) Mode" from "Toolbox". The (IVICS) Mode window will pop up (Figure 18) on your screen. This is a very useful window for several reasons. First, it allows a user to see a "zoomed" image of the imager pixel array chosen on the main image window. This is very useful for finding noisy pixels or for seeing cloud shadows, for example. Second, the user can check the radiometric data for each channel provided in the imager pixel array. Third, and potentially the most interesting aspect of this window, is that it can be used to show the location of pixels within the image which exhibit specific characteristics. The characteristics of interest can be specified using the Graphs window by subsetting a portion of the data from any of the invidual plots. This is done by drawing a box over the data with the mouse (click left on the upper left corner and drag the mouse down). The pixels meeting the user-specified criteria will be highlighted in the Training window.

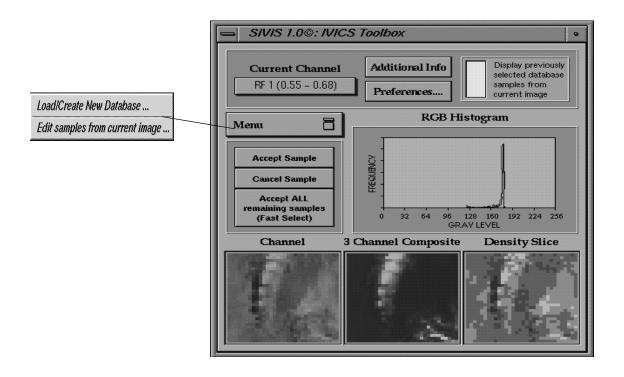


FIGURE 18.

The following **IVICS** utilities are described in more detail below:

# ☐ Hint:

You can do the Density Slice Color Settings first before loading IVICS toolbox by selecting
"Training
(IVICS)..." from
"Preferences".

## ☐ Hint:

It would be wise to save your settings to a file which specifies one of the land surface types. Next time you can select "Load User Defined Settings from file..." to do the same type analysis.

- ♦ Menu Allows you to load, save or edit the samples by *selecting* one of the two options: **Load/Create New Database...** and **Edit samples from current image....** *Selecting* first choice will bring you a dialog window (Figure 19). The procedures are the same as steps ③ and ④ for Loading An Image in Chapter 3.3.
- ◆ Density Slicing -You can set up the reflectance/ brightness temperature range by *pressing* the **Preferences** button. The *IVICS Preferences* window will appear (Figure 20). It tells you the **Current Database**, and **Database Directory**. You can establish your own color settings for different range of reflectance/brightness temperature by *entering* values to these boxes below Density Slice Color Spectrum. *Pressing* "Close" button will close this window.
- ◆ Menu Allows the user to load or save the setting by *electing* one of the three options: **Loading user defaults** setting from file..., Save current settings to file..., and Save setting to Defaults file. *Selecting* either of the first two choices will bring you a dialog window (Figure 21, 22). The procedures are the same as steps ③ and ④ for Loading An Image in Chapter 3.3. *Selecting* the third choice will save the settings in ~HOME/.sivis\_default directory.

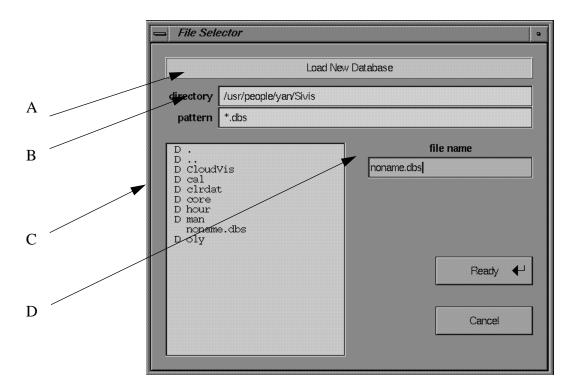


FIGURE 19.

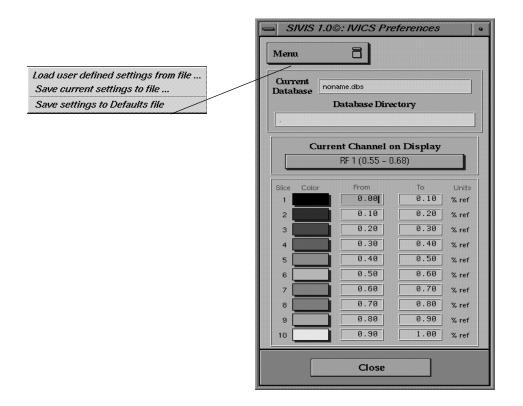


FIGURE 20.

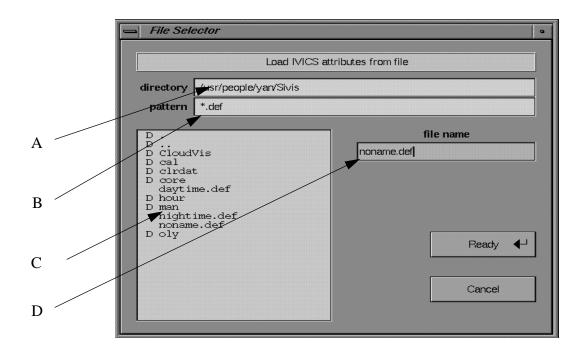
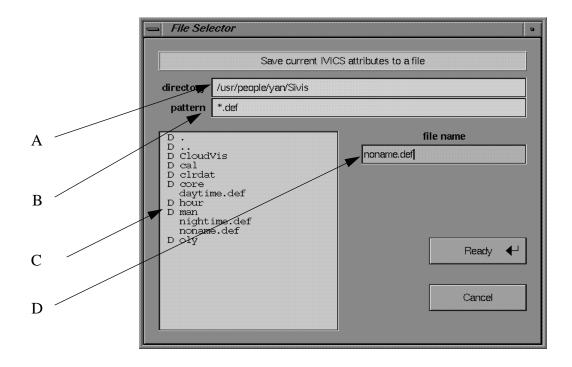


FIGURE 21.



#### FIGURE 22.

- ◆ 3 Channel Composite Displays the zoomed image using the same three-channel combination shown in the *Tile Image* Window.
- ◆ Channel Displays only the currently selected channel in the zoomed image. The selected channel can be changed by *picking* "Current Channel" button.
- ◆ RGB Histogram Displays the RGB Histogram for a selected area. You can change the graph settings by *pressing* the right mouse button on the histogram. See chapter 4.2.1 for details.
- ◆ Displays previously selected samples from the database *Pressing* this button down allows you to display all the samples in the current database that were previously selected for the current image. It helps to avoid duplicate sample entries into the database.

# □ Hint:

Watch the status window closely. It will tell you the information you need.

If you want to save the samples for classification use, you need to load an existing database file for this image first. If no file is loaded, SIVIS will create one for you named *noname.dbs* in your current directory. The samples previously selected will not show up on the *Tile Image* or *Snapshot* window until you *select* "Load/Create"

**New Database**" from "**Menu**". The steps of gathering samples are as follows:

- □ Select one of the Sample Modes which are Drag Box, Single Sample, and Multi-Sample. See chapter 4.2 for details.
- □ Locate the area you are interested in for sampling in the Tile Image window.
- □ ③ Examine the three images carefully by going through Current Channel, and using Additional Info which located in the right top of the window. Make sure the sample you choose represents the characteristics you need. Otherwise, Cancel the sample which is highlighted/selected by checking "Cancel Sample" button. The canceled sample box disappears from the *Tile Image* window.
- ➡ ④ Accept the sample which is highlighted/Selected by *checking* the "Accept Sample" button. If you are in Multi-Sample Mode, *checking* "Accept All Remaining Samples" button will accept all the samples at once. Both actions will bring you the *Data Entry Form* (See Figure 23) to fill up. There are some fields which are automatically filled by SIVIS. You can clear these entries by *pressing* "Clear All Fields" button.
- ➡ ⑤ *Press* "Accept" button to save the new samples to the existing database file.
- □ © Press "Cancel" button to close the window if you want to.

If you want to delete samples which are already in the database file, *select* "Edit Samples From Current Image..." from "Menu". The DB Edit window will pop up (figure 24). The user can also *select* Edit Samples Mode from Sample Mode or Launch Database Tool (DB) either from the command line or from File to edit previous samples. See Programmer's Guide for further information.

#### $\square$ Hint:

To edit previous samples the user can also select Edit Samples Mode from Sample Mode or Launch Database Tool (DB) either from command line or from File.

<b>□</b> DataBase	B1.0: Dat	a Entry Form			
Image Name	/usr/people/y	an/Sivis/cal/861001_00.til			
Time	0.413037		Date	10/01/1986	
Image Y	193			48.539062	
Image X			Longitude	-150.53129	50
Satellite ID	NOAA-F/9		Sample Size	32	
Major Class	ol		Minor Class		_
Image Da	nta	Solar Zenith	61.146763		
Integers.		Viewing Zenith	18.259932		
		Azimuthal Angle	146.601028		
		Scattering Angle	133.422989		
Market 1		Elevation	0.000000		
		Water Content	100.000000		
	7790.000	Sun Glint	0.002981		
Cl	oud Phase		Precipitab	le Water	-999.000000
	opopause	-999.000000		ind Shear	-999.000000
	ility Index	-999.000000	Mean Windspe		-999.000000
Boundary L		-999.000000		(T – Td)	-999.000000
	Air Mass		Surface Tem		-999.000000
Mean Ter	nperature	10.692352	Mean Ref	flectance	32.186607
Top 5% Ter	nperature	14.058655	Top 5% Ref	flectance	48.212685
Bottom 5% Ter	nperature	-11.108429	Bottom 5% Ref	flectance	14.494425
Cor	nments				[%]
]	Feature 🗌				~
	Terrain Oc	ean			<u>×</u>
Eco-	system W	ater			×
Relative L					
Geographic L	ocation				
Accept	:	Clear All	Fields		Cancel

FIGURE 23.

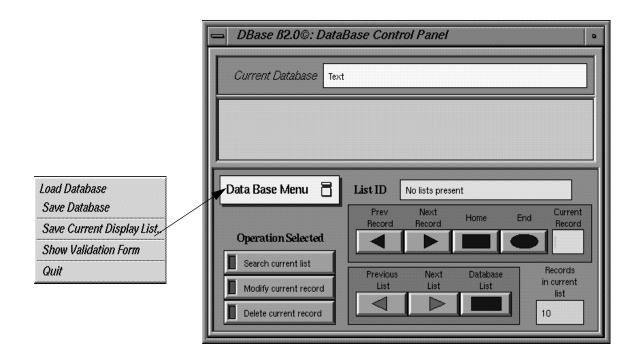


FIGURE 24.

## 4.4 Pixel/Navigation Info

The *pixel/navigation* gizmo is depicted in Figure 25. This tool allows the user to access a multitude of information for each data pixel within the *Tile Image* window by simply moving the mouse pointer (\*\*). Some of the displayed parameters emanate from the input satellite data file itself whereas other information comes from ancillary files residing in the SIVIS software. The ancillary files are of different resolutions. For lower resolution data, individual data values may cover several adjacent pixels when mapped to the image. The resolution of each of the individual files is described below. Here is the list of information in the **Pixel/Navigation** window:

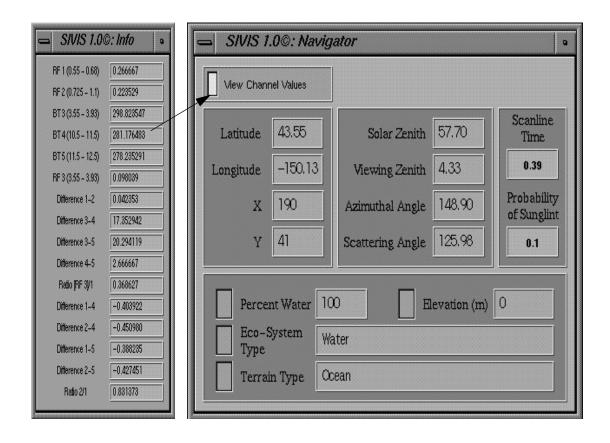


FIGURE 25.

♦ X - Provides the horizontal absolute image pixel location. The range varies from 1 to N, where N represents the number of pixels per scanline for the satellite data file. For AVHRR LAC data files N is 2048, and for AVHRR GAC N is 409. The values increase from left to right on the *Tile Image* window.

## **☐** <u>Hint:</u>

A schematic depicting the various viewing geometry angles is shown in figure 26.

## ☐ <u>Hint:</u>

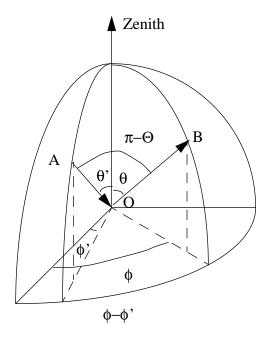
The potential for sun glint is large when the Viewing Angle and Solar Zenith Angle are equal.

## ☐ <u>Hint:</u>

If the **Time** value increases as the mouse is moved up in the **Tile Image**, then the satellite is in ascending mode, and vice versa for descending mode.

- ◆ Y Provides the vertical absolute image pixel location. This value relates to the scanline number and ranges from 1 to the number of scanlines in a file from top to bottom on the *Snapshot Image* window.
- ◆ Latitude, Longitude The geographical location of each pixel. These values are directly from the satellite data file.
- igspace Viewing Zenith (eta) The satellite viewing zenith angle. This value is computed in SIVIS using the input lat/lon information. Angles are shown in Figure 26.
- ♦ Solar Zenith ( $\theta$ ') The solar zenith angle. This value is computed in SIVIS using the input lat/lon information. The color of the values in this box changes to red when the solar zenith angle exceeds the threshold for day-to-night (85 degrees). Angles are shown in Figure 26.
- ♦ Scattering Angle ( $\phi$ - $\phi$ ') The scattering angle based on the viewing geometry. This value is computed in SIVIS using the input lat/lon information. Angles are shown in Figure 26.
- igspace Azimuthal Angle  $(\pi \Theta)$  The relative azimuth angle, i.e., projected angle on the earth surface between Sun and Satellite. This value is computed in SIVIS using the input lat/lon information.
- ◆ Scanline Time Shows users the GMT time in fractions of a minute for each scanline as a function of mouse location within the Tile Image.
- ◆ **Probability of Sunglint** Shows users the Sunglint Probability for each pixel which ranges from 0.0 to 100.0.
- ♦ View Channel Info Activated by *clicking* the adjacent radio button, this choice spawns an additional menu that displays the brightness temperature and reflectance in the 6 channels (Figure 25). The data values update automatically as the mouse is moved around in the Tile Image window.

The relation of those angles are shown in Figure 26.



Relation of scattering, zenith, and azimuthal angles

#### FIGURE 26.

- ♦ % Water Water content provided using NAVY equalangle 10-minute resolution map. The resolution of a typical cell within the 10-min map is about 18 km near the tropics.
- ◆ Elevation Elevation in meters provided using NAVY equal-angle 10-minute resolution map.
- ◆ Eco-Sys Type Ecosystem map provided using EPA equal-angle 10-minute resolution map based on the Olsen vegetation map.
- ◆ **Terrain Type** Geotype map provided using IGBP equal-angle 10-minute resolution map.

These values are provided by default, but the user can toggle off the buttons if desired. You can activate or deactivate these buttons first before loading Pixel/Navigation Info Toolbox by *selecting* "General..." from "Preferences" (See Figure 8). There is an area (See Figure 8, letter A) for Pixel/Navigation Info Set Up Defaults. *Checking/Unchecking* these buttons will activate/deactivate the information shown on the *Pixel/Navigation Info Toolbox* Window.

## 4.5 Overlay

## △ Note:

You need to create an overlay file before selecting it from "File" which is in the Overlay Toolbox window.

**Overlay Toolbox:** allows you to display additional information as an overlay on the image. For example, an aircraft flight track can be overlaid onto an AVHRR image for verification. The overlay data file has a specific format. It normally consists of four columns of ASCII data. One example is shown in Table 2:

TABLE 2.

# of Lines	Lat	Lon	Text	Value
1	-54.12	-179.67	word	0.2
2	-54.21	178.81	word	0.2
3	-53.80	179.96	word	0.2
4	-53.48	179.62	word	0.4
5	-58.91	151.36	word	0.2
6	-58.85	152.18	word	0.3
7	-58.46	156.20	word	0.2
	•••	•••	•••	

The first and second columns of the data are latitude and longitude. The third column is text and the fourth column is a numerical value. If the user does not want to overlay either text or numbers, then "\*" should be written in the third column and "0" should be written in the fourth column.

*Select* "Overlay" from "Toolbox" text icon in the main control window to open *Overlay Toolbox* window shown in Figure 21. There are several items in this window:

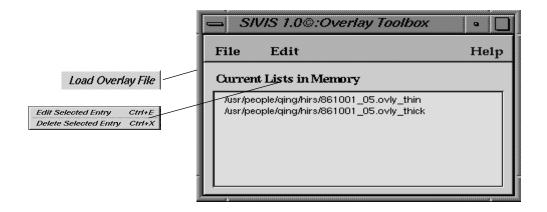
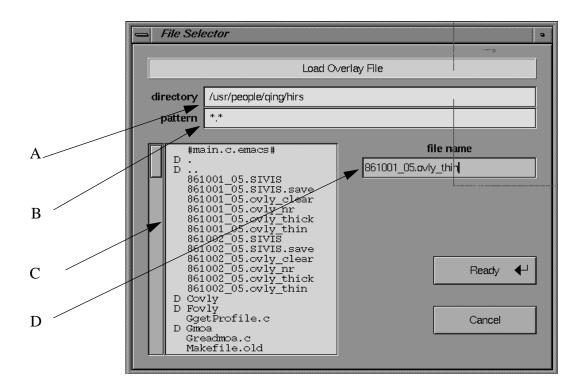


FIGURE 27.

◆ File - Allows the user to load overlay files by *selecting* "Load Overlay File" from "File". The *Load Overlay File* window will show up (Figure 28). Procedures for loading an overlay file are same as steps ③ and )④ for Loading An Image in chapter 3.3. When finished loading, bunch of red crosses representing the overlay points will appear on the *Tile Image* window and the *Snapshot Image* window (if it is opened). The corresponding file name will appear under Current Lists in Memory.



#### FIGURE 28.

◆ Edit - Lets the user Edit Selected Entry or Delete Selected Entry.

**Edit Selected Entry** Allows the user to change the shape and color of overlay symbols. Highlight the desired overlay file name, and select **Edit Selected Entry** (or *double click* the right mouse button on desired file name). The *Overlay Preference* window will appear (Figure 29):



FIGURE 29.

- ◆ **Display/Hide Overlay Entry** Allows the user to display or hide the overlay symbols for the desired file. This feature come handy when there are more than one file overlaid.
- ◆ Object Type Allows the user to choose a different shape for the overlay symbol. If the user wishes to use polygons or ellipses as overlay symbols, a different ASCII format must be used for the overlay file. These formats will be discussed at end of this section.
- ◆ **Text Size** Allows the user to change the size of overlaid text.
- ◆ Text Font Style Allows the user to choose different font for overlaid text.
- ◆ **Show None** Only shows the overlay symbols without showing text and value.
- ◆ **Show Text** Shows overlay text.
- ◆ **Show Value** Shows overlay value.
- ◆ **Text Color** Lets the user change the color of text.
- ◆ **Object Color** Lets the user change the color of the overlay symbol.

- ◆ **Apply** *Press* this button to accept all the changes you made.
- ◆ Cancel *Press* this button to discard the changes and close the window.

**Delete Selected Entry** - Allows the user to delete an overlay file which is highlighted in **Current Lists in Memory**.

◆ Current Lists in Memory - shows all the overlay files the user has currently loaded. Each overlay entry can be selected by *clicking* the left mouse button on it. The selected entry will be highlighted.

For user-defined ellipses or polygons: If the user wants to use either polygons or ellipses as the overlay object type, the format of the overlay file should look like:

Point Object:

<x1> <y1> <text> <numeric>

Polygon Object:

<x1> <y1> <x2> <y2> <x3> <y3> <x4> <y4> <text> <numeric>

For Ellipse Object:

 $\langle x1 \rangle \langle y1 \rangle \langle d1 \rangle \langle d2 \rangle \langle text \rangle \langle numeric \rangle$ 

x and y here are latitude and longitude of the point in this image. CHECK **Pixel/Navigation** Tool first to make sure the location you desire.

Figure 30 illustrates these objects.

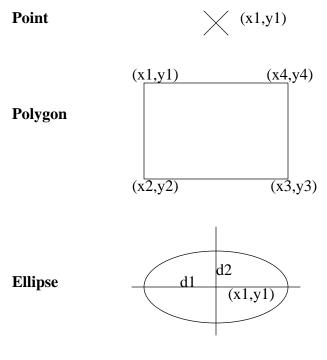


FIGURE 30.

#### 4.6 Cloud Mask Gizmo

The *Cloud Mask* tool gives users an opportunity to test their own cloud-clearing algorithms interactively by typing formatted conditions and applying the conditions to an image. Results from application of user-specified conditions are overlaid onto the real image and shown on a separate *Cloud Mask* window. The user can compare the cloud mask result screen with the corresponding satellite image on *Tile Image*.

The basic procedures for using this tool are as follows:

- ➡ ① Select "Cloud Mask" from "Toolbox". The Mask Results and Mask Toolbox windows will pop up (Figure 32) on your screen.
- □ ③ *Click* the **Add** button on the right side of the *Mask Tool* window. The *Editor* window (See Figure 33) will appear. *Type* in the condition for the test in the *Editor* window. For illustrative purposes, we present a set of tests for

sunglint in AVHRR imagery. Figure 31 explains what the conditions are and the meaning of each variable.

The results of conditions can be assigned specific colors for display. The assignment is made by using numbers which are associated with colors. The colors that are availabe for display (numbered from 0 to 7) are listed in Table 3. If the user wants more color choices, they can be found on plate 2. On this plate, colors are numbered from 0 to 7 in the first row and 8 to 15 in the second row, and so forth from 56 to 63 in eighth row. The syntax for writing this condition will be explained in details at the end of this section.

Type in a name in condition name box, and Press "Accept" button to compile the test. If there are syntax errors, the message window (Figure 34) will give you the information necessary to correct the errors. If there is a problem with compilation of an individual test, Click "Ok" on this window and modify the condition. If the condition is compiled successfully, then the condition will show up on the Mask Tool window. The user can type in up to a maximum of 50 tests. However, the user can only type in one condition at a time in Editor window. The arrows on the right top corner of the Mask Tool window are for users to browse these conditions one by one.

# **Sunglint Test of GAC Data used for Cloud Mask**

**Condition 1:** Iif the brightness temperature of channel 3 (b3) is less than 303.0 AND the reflectance of channel 1 (b1) is greater than 0.10 set the color to blue. Otherwise, set the color to black. This is for sunglint over cloud.

Condition 2: If the ratio of reflectance of channel 3 to channel 1 (b6/b1) is greater than 0.70 AND the reflectance of channel 1 (b1) is greater than and equal to 0.10, set the color to lavender. Otherwise, set the color to black. This is for sunglint over clear-sky with low reflectance. Condition 3 says if the brightness temperature of channel 3 (b3) is equal to 320.0 AND the reflectance of channel 1 (b1) is greater than 0.24, set the color to red. Otherwise, set the color to black. This is for sunglint over clear-sky with high reflectance.

## FIGURE 31.

#### TABLE 3.

Color	0	1	2	3	4	5	6	7
Number	black	red	green	yellow	blue	magenta	cyan	white

#### ☐ Hint:

Several conditions can be put together to test the algorithms but it takes longer to show the results. ➡ ④ *Check/Uncheck* the **Select** button will active/deactive the conditions shown in the *Mask Tool* window. While there may be a long list of conditions in the list, the user can choose a subset for testing purposes. There are two small boxes in the right bottom of *Mask Tool* window which give you additional information: **Displayed Conditions** and **Number of Conditions**.

➡ ⑤ *Click* the **Test Mask** button. The results will show on the *Mask Results* window. For example, if you have three conditions that return the red, green and blue colors individually, the final result screen will superimpose the three colors for those pixels in which all three tests were true. Thus, the white color results if all three conditions are satisfied.

The user can **modify**, **delete** and **clear all** the conditions by *click-ing* the corresponding buttons on the *Mask Toolbox* window. If the **modify** button is invoked, the *Editor* window will be shown with the condition inside. (See Figure 33). The user can change the thresholds and colors within this window and also change the condition names. If the user neglects to type in a name for the suite of tests, a default name will be chosen. The name will be displayed on the *Mask Tool* window. *Press* "Accept" button to accept the modifications or the "Cancel" button if you change your mind. *Pressing* the "Cancel" button also closes this window. *Clicking* the **Delete** button only deletes the condition which is currently shown on the *Mask tool* window. *Clicking* the **Delete All** button will kill all the conditions.

Once the user has derived a useful set of conditions, the conditions may be saved by three means. They are **Save Conditions to File...**, Save as "C" functions..., and Save as "F77" functions.... The first option, **Save Conditions to File**, saves the suite of tests in internal SIVIS format, so the user can pull up the suite of tests at any future time. The user also has the option for saving the suite of tests in both C and Fortran formats (which may not be implemented quite yet), so that a suite of tests developed, for example, for daytime polar cloud masking may be used in an operational cloud retrieval code external to SIVIS. The condition name will become the function name. These options are from File on the Mask Toolbox window. The File Selector window will show up if any of the three options are invoked (Figure 32). Procedures for loading a condition file or saving a condition file are the same as steps 3 and )4 for Loading An Image in chapter 3.3. It is easier for the user to load different conditions for different algorithms by selecting Load **Conditions** from **File...** as well as to write functions into programs.

Another feature of **Cloud Mask** tool is that the user can *select* samples on the Tile Image which will have corresponding samples on the *Cloud Mask* window. It gives the user an opportunity to analyze his/her algorithms and adjust the thresholds based on the information obtained using **Graphs**. See chapter 4.2 for details.

The mask toolbox allows conditions in the form as described below:

```
if[ condition ]
```

statement1

else

statement2

#### statements 1 & 2:

As this is a visualization tool, statements 1 and 2 are always color assignment statements. They are of the form:

```
color = #
```

(where # is a number associated with the desired color)

if:

The toolbox handles one if-then-else per condition. If more than one condition is entered, it considers just the first "if" condition and ignores the rest. The if-then-else is structured based on the 'C' language constructs. If the condition is TRUE, then statement 1 is considered, else statement 2. If more than one condition is added to the system, then, the toolbox "OR" is the colors of the 2 or more conditions that are TRUE for a pixel, creating a visually logical color. For e.g.:-if 2 conditions pass on a pixel and have "red" and "blue" as their colors, then, that pixel will get the color "magenta". If it is desired to over-ride this feature, and force a color on a pixel, then "IF" can be used for the condition "if". This guarantees the color for the pixel if TRUE. However, these conditions should be entered in last as the conditions are executed in the order they are entered.

#### condition:

The condition in the "if" construct can be a simple or complex condition.

A simple condition is of the form:

<attribute 1> <relational operator> <attribute 2>

Note: A simple condition cannot be enclosed in parenthesis.

<a tribute 1> & <a tribute 2> can be band variables, mathematical expressions involving band variables, terrain type variables or constants. Band variables and mathematical expressions should be represented in curly braces ( $\{$  and  $\}$ ). The relational operator should be one of  $\{$  ==, >=, <=, <, > $\}$ . Examples of different attribute types are given below:

a) Simple condition involving band variable and a constant:

#### Statement:

```
if ( Band 1 > 0.16 )
then
  color = red;
else
  color = blue;
```

## Condition:

```
if [ \{b1\} > 0.16 ]

color = 1

else

color = 4
```

b) Simple condition involving expressions of band variables and a constant:

#### Statement:

## Condition:

```
if [ \{(b1-b2)/(b1+b2)\} > 0.16 ]
color = 1
else
color = 4
```

c) Simple condition involving expressions of band variable and constants:

#### Statement:

```
if ( (Band 1 - Band 2)/(Band 1 + Band 2) > 0.16*200+3 ) then  color = red;  else  color = blue;
```

## Condition:

```
if [ \{(b1-b2)/(b1+b2)\} > \{0.16*200 + 3\} ] 
 color = 1 
 else 
 color = 4
```

Note:- All expressions should be enclosed in curly braces.

Complex condition: A complex condition is obtained by "OR"ing or "AND"ing two or more simple conditions.

e.g.:-

# Statement:

```
if ( Band 1 > 0.5 && (Band1/Band2) < 0.4)
then
  color = red;
else
  color = blue;</pre>
```

# Condition:

```
if [ \{b1\} > 0.5 \&\& \{b1/b2\} < 0.4 ]  color = 1   else   color = 4
```

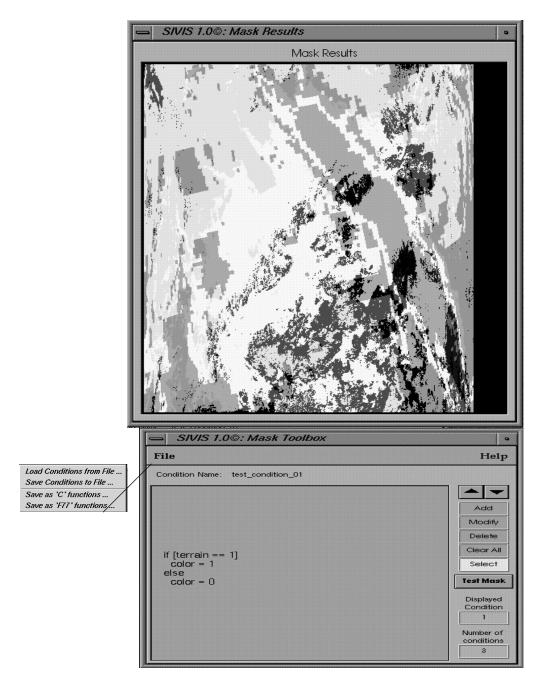


FIGURE 32.

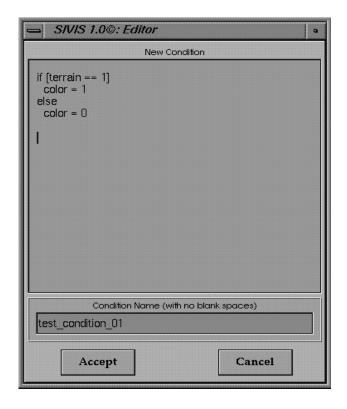


FIGURE 33.

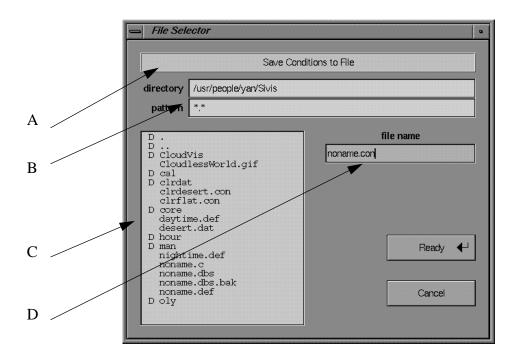


FIGURE 34.

## 4.7 Ceres CloudVis Product

The *Ceres CloudVis* tool provides the ability for direct comparisons between AVHRR imagery and output from the CERES operational cloud retrieval algorithms. The main requirement for implementation of this tool is a processed CERES cloud algorithm output file. Presently, CERES output files are processed for increments of one hour of data (the CERES definition of a granule) but saved only for subsets of AVHRR Global Area Coverage (GAC) data, generally 512 scanlines, to reduce data volume. There two steps to using this tool:

## ☐ Hint:

CERES Results tool may not be used UNTIL an output file is loaded using the "Load Results" option off of the File text icon on the main Control Window

- ➡ ① Loading a CERES Results file. This is done EXTER-NALLY from the tool, via the *File* text icon on the main *Control Window* (See Figure 1). Procedures for loading a CloudVis file are the same as steps ③ and )④for Loading An Image in chapter 3.3. The file is successfully loaded when the message "Done reading results file" appears in the *Status* toolbox.
- Due to the fixed size requirements of the Tile Image window, the region represented on the CERES Results window cannot be represented on the CERES Results window cannot be represented on the CERES Results window cannot be represented on the CERES Results window cannot be represented on the CERES Results window cannot be represented completely at one time on the Tile Image window. The user must toggle up and down using the arrow keys on the right edge of the window. Also only a small portion of the output file is actually shown in the CERES Results window at one time. The slider bar on the right allows the user to look at the whole output file.

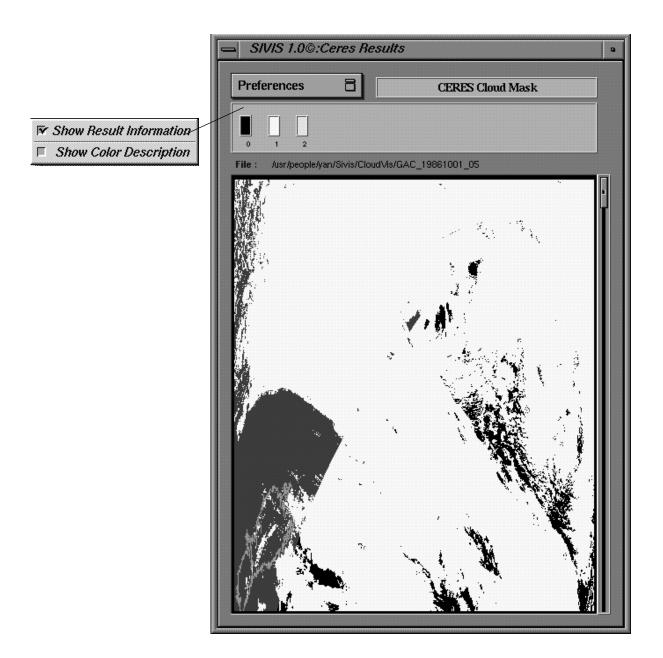


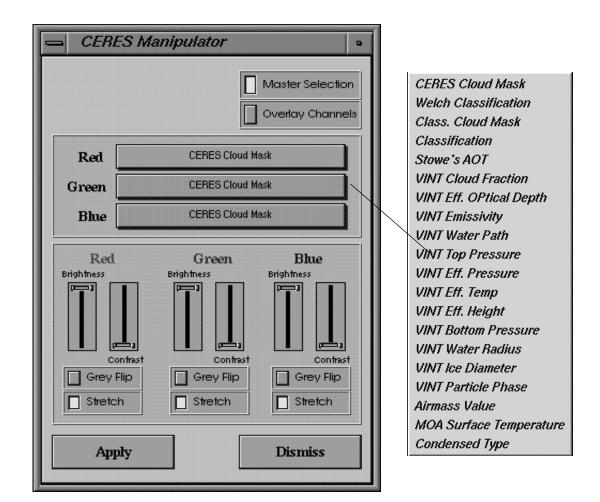
FIGURE 35.

There are two main functions built into the *CERES Results* tool. The first one is the ability to view any one CERES Output parameter over the whole image. By default, the results of the CERES cloud mask are shown on start-up. The results are "auto grey scaled" based on the range of values of the displayed parameter. For example, for cloud heights the values range from 0 to 20 kilometers. An output file with uniform low clouds (< 2 km) would

appears as dark grey with little white, whereas an output file with broken high clouds would appear as grey tones from near black to near white. Output parameters with discrete distributions such as cloud particle phase (either none, water, or ice) are generally more comprehensible visually than those with continuous distributions such as effective radius.

To alter the field displayed, simply *click* the right mouse button on the top of the image within the *CERES Results* window. The *CERES Manipulator* window will appear (See Figure 36). This tool operates just like the same tool for the satellite images. Notice that all three color channels are mapped with the same CERES output parameter. To change parameters, simply *click* the right mouse button on any of the three channels where the parameter is listed. When the whole list of choices appears *slide* the mouse down to the desired choice and *click*.

If the user desires to view more than one output parameter at the same time, it can be done by *deactivating* the master selection mode and choosing different parameters for each of the three colors. The selection method is the same as described above. This feature is potentially very useful, but often yields somewhat "hard-to-interpret" images, so it is not highly publicized.



#### FIGURE 36.

The second main function is similar to the *pixel navigation* tool for the satellite images. Through mouse navigation within the *CERES Results* window, the user may view the results for ALL CERES Output parameters for an individual CERES imager pixel. This tool is initiated by *clicking* on the **Preferences** button located on the upper left-hand corner of the image (See Figure 36). The submenu "**Show Results Information**" shows. *Checking* this box by *pressing* the left mouse button will bring the *CERES Info* window (Figure 38). The window is undersized on start-up, and can be resized by "grabbing" the lower right corner of the window, and dragging the window down and to the right. You also can get the color information for the mask results window by *Checking* "Show Color Information". It will brings up the Color info Window (See figure 37). You can change the limits to alter the result image.

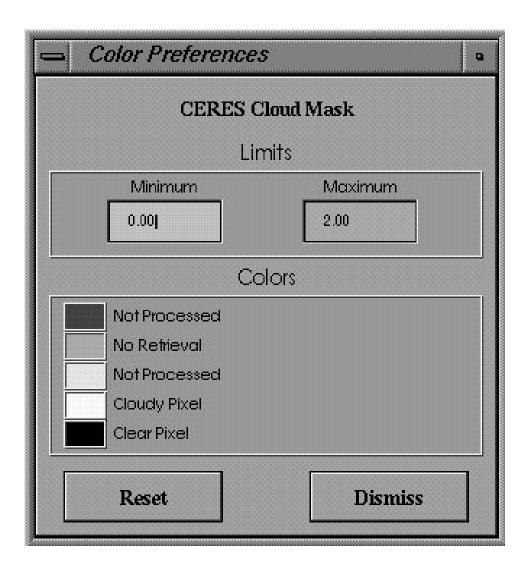


FIGURE 37.

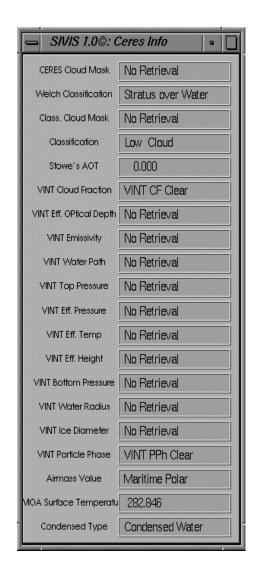


FIGURE 38.

The capability to make direct comparison between individual pixels on the *Tile Image* and the *CERES Results* tools is not currently developed. The only means to make cross-comparisons is within the *Graphs* tool. When the drag mode is implemented, the drag box is shown on BOTH the *Tile Image* and *CERES Results* windows. It helps the user to locate the interested area and get auxillary information by using other tools. For example, the user could load toolbox "Graph" to figure out the characteristics of the area of interest by *locating* it on both windows.

## 4.8 HIRS Viewer

△ Note:

You need to select "Load HIRS File" from the File text icon before select ing "Hirs Viewer" from Toolbox..

The **HIRS Toolbox** is designed to let the user view cloud retrieval results from HIRS measurements. Select "Load HIRS File" under the "File" text icon in the *Main Control* Window to load a HIRS/2 output file. We note that there is a specific format used for generating a HIRS/2 output file (available upon request). The output file contains, for each HIRS/2 field-of-view (FOV), brightness temperatures derived for the 19 NIR and IR channels, a reflectance for channel 20, brightness temperature differences between selected channel pairs, and cloud-top pressures and effective cloud fractions derived from application of the CO2 slicing algorithm. A dialogue window will show up (Figure 39). Procedures for loading a HIRS output file are the same as steps 3 and 14 for Loading An Image in chapter 3.3. The file is successfully loaded when the message "Done loading HIRS file in 00:04:30" appears in the Status Toolbox. It takes about 4.5 minutes to load one hour of HIRS output file (about 563 scanlines).

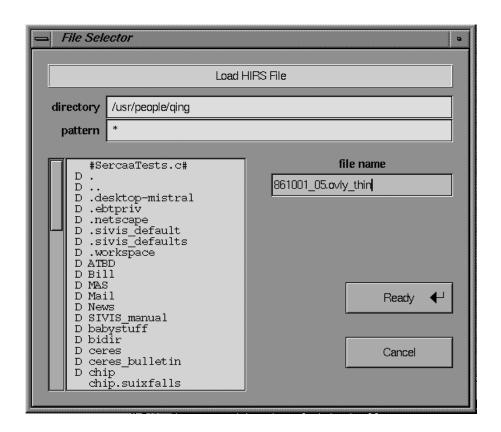


FIGURE 39.

After finishing loading, *select* "**HIRS Viewer**" under the "**Tool-box**" text icon in the *Main Control* Window. The *HIRS Toolbox* window shows up (see Plate 4 at the end of this manual). Thd user

will see red ellipses overlaid on the AVHRR image. Each ellipse represents one HIRS field-of-view. There are 56 FOVs on each scan line. The gaps in the HIRS result indicate calibration lines.

In Plate 4, the icons above the image are (from left to right):

- ◆ Julian Day the julian day of the HIRS output.
- ◆ Date the calender date of the HIRS output.
- ◆ Start Time starting GMT time of the HIRS output.
- ◆ End Time ending GMT time of the HIRS output.
- ◆ Scanlines number of HIRS scan lines in the output file including calibration lines.

The icons on the right are:

- ◆ **Preferences** under development.
- ♦ Channel Values brightness temperature of 19 NIR and IR HIRS2 channels, and reflectance for channel 20. Their corresponding wavelengths are shown in brackets.
- ◆ Channel Differences brightness temperature differences of two HIRS2 channels. They provide information necessary for an experienced user to infer information about cloud type, cloud phase, and cloud-base height etc.
- ◆ Pressure Retrievals retrieved cloud pressure (from the CO<sub>2</sub> slicing method) from different HIRS channel combinations, e.g., **B4/B5** is the cloud pressure retrieval from channel 4 and channel 5, **Final Res** is the final retrieved cloud pressure for that FOV.
- ◆ Effective Cloud Amounts retrieved effective cloud amount from different HIRS channel combinations, e.g., B4/B5 is the effective cloud amount retrieval from channel 4 and channel 5, Final (B8) is the cloud emittance from window channel (channel 8).

To view cloud retrieval results for a particular HIRS FOV, *move* the cursor into the ellipse corresponding to that FOV and *click* the left mouse button; values on the right side will update to the retrieved results for the selected FOV. Results in Plate 4 correspond to the FOV pointed to by the white arrow.

# 5.0 List of Acronyms

# TABLE 4.

AVHRR Advanced Very High Resolution Radiometer BTD Brightness Temperature Differences CERES Clouds and the Earth's Radiant Energy System DAAC Distributed Active Archive Center ECMWF European Centre for Medium-Range Weather Forecast EOS Earth Observing System EOS-AM EOS Morning Crossing Mission EOS-PM EOS afternoon Crossing Mission EPA Environmental Protection Agency ERB Earth Radiation Budget ERBE Earth Radiation Budget Experiment ERBS Earth Radiation Budget Satellite FIRE First ISCCP Regional Experiment FIRE II IFO First ISCCP Regional Experiment II Intensive Field Observations GAC Global Area Coverage GOES Geostationary Operational Environmental Satellite HBTM Hybrid Bispectral Threshold Method HIRS High Resolution Infrared Radiation Sounder ISCCP International Satellite Cloud Climatology Project IVICS Interactive Visual Image Classification System IWP Ice Water Path LAC Local Area Coverage (AVHRR data mode)
CERES Clouds and the Earth's Radiant Energy System  DAAC Distributed Active Archive Center  ECMWF European Centre for Medium-Range Weather Forecast  EOS Earth Observing System  EOS-AM EOS Morning Crossing Mission  EOS-PM EOS afternoon Crossing Mission  EPA Environmental Protection Agency  ERB Earth Radiation Budget  ERBE Earth Radiation Budget Experiment  ERBS Earth Radiation Budget Satellite  FIRE First ISCCP Regional Experiment  FIRE II IFO First ISCCP Regional Experiment II Intensive Field Observations  GAC Global Area Coverage  GOES Geostationary Operational Environmental Satellite  HBTM Hybrid Bispectral Threshold Method  HIRS High Resolution Infrared Radiation Sounder  ISCCP International Satellite Cloud Climatology Project  IVICS Interactive Visual Image Classification System  IWP Ice Water Path
DAAC Distributed Active Archive Center  ECMWF European Centre for Medium-Range Weather Forecast  EOS Earth Observing System  EOS-AM EOS Morning Crossing Mission  EOS-PM EOS afternoon Crossing Mission  EPA Environmental Protection Agency  ERB Earth Radiation Budget  ERBE Earth Radiation Budget Experiment  ERBS Earth Radiation Budget Satellite  FIRE First ISCCP Regional Experiment  FIRE II IFO First ISCCP Regional Experiment II Intensive Field Observations  GAC Global Area Coverage  GOES Geostationary Operational Environmental Satellite  HBTM Hybrid Bispectral Threshold Method  HIRS High Resolution Infrared Radiation Sounder  ISCCP International Satellite Cloud Climatology Project  IVICS Interactive Visual Image Classification System  IWP Ice Water Path
ECMWF European Centre for Medium-Range Weather Forecast  EOS Earth Observing System  EOS-AM EOS Morning Crossing Mission  EOS-PM EOS afternoon Crossing Mission  EPA Environmental Protection Agency  ERB Earth Radiation Budget  ERBE Earth Radiation Budget Experiment  ERBS Earth Radiation Budget Satellite  FIRE First ISCCP Regional Experiment  FIRE II IFO First ISCCP Regional Experiment II Intensive Field Observations  GAC Global Area Coverage  GOES Geostationary Operational Environmental Satellite  HBTM Hybrid Bispectral Threshold Method  HIRS High Resolution Infrared Radiation Sounder  ISCCP International Satellite Cloud Climatology Project  IVICS Interactive Visual Image Classification System  IWP Ice Water Path
EOS Earth Observing System  EOS-AM EOS Morning Crossing Mission  EOS-PM EOS afternoon Crossing Mission  EPA Environmental Protection Agency  ERB Earth Radiation Budget  ERBE Earth Radiation Budget Experiment  ERBS Earth Radiation Budget Satellite  FIRE First ISCCP Regional Experiment  FIRE II IFO First ISCCP Regional Experiment II Intensive Field Observations  GAC Global Area Coverage  GOES Geostationary Operational Environmental Satellite  HBTM Hybrid Bispectral Threshold Method  HIRS High Resolution Infrared Radiation Sounder  ISCCP International Satellite Cloud Climatology Project  IVICS Interactive Visual Image Classification System  IWP Ice Water Path
EOS-AM EOS Morning Crossing Mission EOS-PM EOS afternoon Crossing Mission EPA Environmental Protection Agency ERB Earth Radiation Budget ERBE Earth Radiation Budget Experiment ERBS Earth Radiation Budget Satellite FIRE First ISCCP Regional Experiment FIRE II IFO First ISCCP Regional Experiment II Intensive Field Observations GAC Global Area Coverage GOES Geostationary Operational Environmental Satellite HBTM Hybrid Bispectral Threshold Method HIRS High Resolution Infrared Radiation Sounder ISCCP International Satellite Cloud Climatology Project IVICS Interactive Visual Image Classification System IWP Ice Water Path
EOS-PM EOS afternoon Crossing Mission  EPA Environmental Protection Agency  ERB Earth Radiation Budget  ERBE Earth Radiation Budget Experiment  ERBS Earth Radiation Budget Satellite  FIRE First ISCCP Regional Experiment  FIRE II IFO First ISCCP Regional Experiment II Intensive Field Observations  GAC Global Area Coverage  GOES Geostationary Operational Environmental Satellite  HBTM Hybrid Bispectral Threshold Method  HIRS High Resolution Infrared Radiation Sounder  ISCCP International Satellite Cloud Climatology Project  IVICS Interactive Visual Image Classification System  IWP Ice Water Path
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ERB Earth Radiation Budget Experiment  ERBS Earth Radiation Budget Satellite  FIRE First ISCCP Regional Experiment  FIRE II IFO First ISCCP Regional Experiment II Intensive Field Observations  GAC Global Area Coverage  GOES Geostationary Operational Environmental Satellite  HBTM Hybrid Bispectral Threshold Method  HIRS High Resolution Infrared Radiation Sounder  ISCCP International Satellite Cloud Climatology Project  IVICS Interactive Visual Image Classification System  IWP Ice Water Path
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FIRE II IFO First ISCCP Regional Experiment II Intensive Field Observations GAC Global Area Coverage GOES Geostationary Operational Environmental Satellite HBTM Hybrid Bispectral Threshold Method HIRS High Resolution Infrared Radiation Sounder ISCCP International Satellite Cloud Climatology Project IVICS Interactive Visual Image Classification System IWP Ice Water Path
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HIRS High Resolution Infrared Radiation Sounder ISCCP International Satellite Cloud Climatology Project IVICS Interactive Visual Image Classification System IWP Ice Water Path
ISCCP International Satellite Cloud Climatology Project  IVICS Interactive Visual Image Classification System  IWP Ice Water Path
IVICS Interactive Visual Image Classification System IWP Ice Water Path
IWP Ice Water Path
LAC Local Area Coverage (AVHRR data mode)
LaRC Langley Research Center
MODIS Moderate-Resolution Imaging Spectroradiometer
MSMR Multispectral, multiresolution
NASA National Aeronautics and Space Administration
NMC National Meteorological Center
NOAA National Oceanic and Atmospheric Administration
SARB Surface and Atmospheric Radiation Budget Working Group
SIVIS Satellite Imagery Visualization System

TABLE 4.

ACRONYM	DESCRIPTION
SRB	Surface Radiation Budget
SST	Sea Surface Temperature
TIROS	Television Infrared Observation Satellite
TOA	Top of the Atmosphere
TOVS	TIROS Operational Vertical Sounder
TRMM	Tropical Rainfall Measuring Mission
UTC	Universal Time Code
VINT	Visible Infrared Near infrared Technique

TABLE 5.

Number of Channel	Unit of measure	Wave Length Range (μm)
1	Reflectivity	0.55 - 0.68
2	Reflectivity	0.725 - 1.1
3	Brightness Temperature	3.55 - 3.93
4	Brightness Temperature	10.5 - 11.5
5	Brightness Temperature	11.5 - 12.5
6	Reflectivity	3.55 - 3.93

65